Menlo Park Notebook #158 [N-81-03-22]

This notebook is undated with the exception of one entry for March 22, 1881. All of the entries are by Francis Upton. Edison's name or initials appear on many of the entries. The book contains notes, calculations, and a few drawings relating to conductors for the Pearl Street district. The label on the front cover is marked "Conductors." The book contains 284 numbered pages.

Blank pages not filmed: 184-277, 280-281.

x E-172 N-81.03-22

I propose as a system to carry around each square a wire of uniform size so that only 2.5 Volts shall be lost in the wire. Also to connect in the interior each distributing point with the other points so that there will be a fall of 2.5 Volts along the distributing wires.

The increase of weight to making the cable of uniform size is 1.165 times as much as when it is decreasing.

log 1.165 = 0665
.19
.0664

6.3933
6.4597

Block 1

3.1314
.0664
3.1978 — 1570

3.0503
.0664
3.1167 — 1300

TM

Block 2

488
489
20
137
2|1132
566

6.4597
2.7528
33 2.7528
1.35185
34838 .3040

Block 3

574
510
20
137
1181
596

30

6.4597
2.7709
2.7709
1.4771
3.4486

3081

Jas.

Block 4

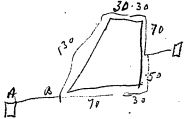
1020
87
20
1127
583

3.4

6.4597
2.7505
2.7505
1.5315
3.4922

3110

Block 5



169

20
10
8
51
162

A.B. 10 lamps to 3.2 Ubs
20
640

23 & 64 1.3617 1.8062 2.1679 1470

2 Volts fall around block
160 lamps 5 | 1030 206 1236

3.0920 .0664 3.1584 1440

904 2.1956 2 .6664 3.0226 1050

80 6.4567 1.4771 2.4771 0.9436 2.1140 130

4090

Block 6

4 M

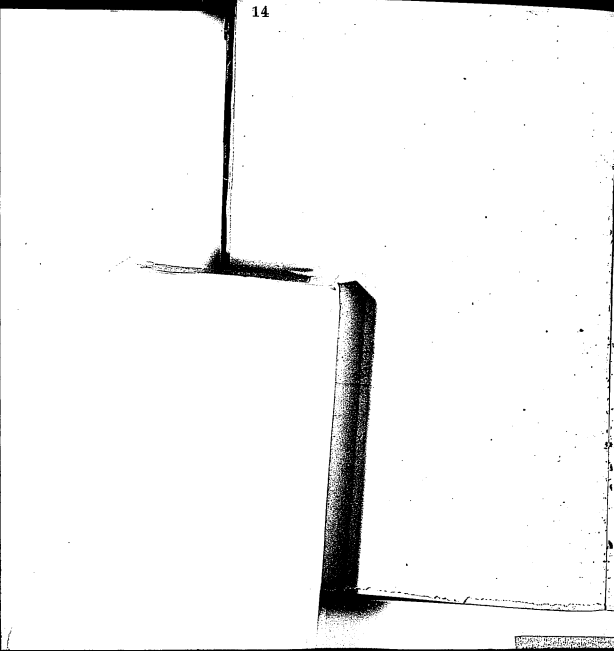
3.1313
.0664
3.1977 1570

6 M

2.5229
.0664
2.5893 388

10
64
20
328
44
466
233

6.4567
2.3674
2.3674
1.0792
12
2.2707 186
2144



Block 8

529
1

3.1191
.0664
3.1855

4.49

1535

1 : 1

120
@

3.0

6.4597
2.0792
2.0792
0.4771
1.0952

12

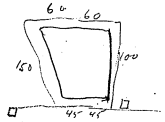
Block 9

148
20
341
10
80
549

6.45-67
2.7396
2.7396
1.2041
3.1400
16

3796
1380
5176

Block 9



150
60
45
25.5
150 feet

2.81
20
56.20
25.5

1.7497
1.4065
3.1562
1430

376
10
20
148
554
21

6.45-97
2.7435
2.7435
r .3222
3.2689

5 1850
370
2220

185
40
10
235
1.17

9

6.45-97
2.3711
2.3711
0.95-92
2.1661

2220
148
3796

Block 10

3.1278
.0664
3.1942

1580

Tag

Block 11

3.1074
.0664
3.1738

1500
200
1700

TJE

Block 12

30
19.
140
2.0
500
20
108
13

850

425.

6.4597
2.6284
22 2.6284
1.3424
3.0589

200
1140
1340

Tax

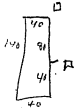
Block 13

1000	6.45 97
40	2.8209
60	2.8209
130	
115	24 1.3802
1325	3.4817
662	

3020

Led entirely from one side

TAE



30	
136	
220	
140	
20	
115	
166	

Block 13

920 feet

396 feet

792

1540

792

105.8

20.

105.8
110

105.8
1058
1163.8

20
20
220

1160
220
940

940
1880
1880

w = weight of wire
a = Cross section in .0001
l = length. unit =
r = resistance

W = Wt. of a wire two feet long the cross section of wh. is 0.0001 sq. in.

R = Resistance of wire two feet long with cross section of 0.0001 sq. in.

$w = l\,a\,W$

$a = \frac{w}{l\,W}$

TAF

Three feet one wire weighs 500 lbs. and has a cross section of .0324 sq. in.

Cross section of .0001

500
.0324
15.1

2.6990
2.5105
.1885
303010

lbs in 3000 feet

log W = 6.88875
comp log W = 3.1125

28

4941
3202
8144

Around block
1512
3915
2940
8367

Block 1

29

604
20
20
644 feet

2.8089
2.8089
27 1.4314
6.0492
6.3933
34427
·0664
3.5091

2777
3203

3.5091
7.1918
3.1125
·8127

·6510

TAE

3.2773
7.2306
3.1125
3.6204 .4170

2.7305
7.3696
3.1125
3.2126 .1630

1.5576
7.7520
3.1125
2.4223 .0290

Block 2

2.7694
2.7694
1.2778
6.3933
3.2109
.0664
3.2773

387
10
30
427

137
10
30
177

365
30
20
142 1620 1890
16
588

Increasing Strength

2.6304
2.6304
1
6.3933 461 537
2.6641
.0664
2.7305

2.2480
2.2480
0.6021
6.3933 81 36
1.4914
.0664 2182463
5578

TAE

514
510
137
20
20
1201
60·0

2.7782
2·7782
30 1.4771
6.3933
3·4268
0664
3.4932
7.2218
3.1125
3.8275

2670 3110

TAE

·672

Block 4

1020
80
20
35
1155
577

2.7612
2.7612
34 1.5315
6.3933
3.4472
.0664
3.5136
7.2385
3.1125
3.9649

2800 3260

TAE

.732

4.47780
2.86111
1.91669
− 82

C = 20
20
264
20
20
364
182
82
.100

6
4

Reciprocals

Block 5

$$X = \frac{(b-a)(b+a)^{\frac{1}{2}}}{6\,\varepsilon\,c} + \frac{c}{2}$$

a = 472
b = 762
c = 1022
30
1052
526

762
472
290

472
762
1234

3.0912
2.4624
8.9254
4.47780
3.02220
1.45560

TAE

1052
554
498

526
28
554
498

30
40
20
490

Decreasing same angle

1.45560
.06644
1.38916

245

2.9862
7.3098
3.1125
3.4085 .256

3.1622
7.2583
3.1125
3.5260 .336

2.1910
7.5719
3.1125
2.8754 .075

Block 5

90
10
420
20
30
490

2.6902
2.6902
14 1.1761
6.3933
2.9198
.0664
2.9862

831 .969

TAE

1052
490
.562

2.7497
2.7497
16 1.2044
6.3933
3.0468
.0664
3.1632

1250 1450

264
66 364
80 96
96 268

1.9823
1.9823
25 0.3979
6.3933
.7558
2.4281
2.4281
0.8751
6.3933
2.1244
.0266
2.1910

7.5 10

266

133. 155

2289. 2584

3.2689
7.2565
3.1125
3.6379 .433

2.1197
7.3591
3.1125
2.7913 .069

2.7489
7.3325
3.1125
3.1939 .156

Block 67

267
53
214
20
198
25
44
10
33
554
328
82
240
30
276
30
162
25
190
58
46.5

2.7435
2.7435
0.3222
6.3933
3.2025 1590 1850
.0664
3.2689

2.4409
2.4409
0.7782
6.3732
2.0533 113 131
.0664
2.1197

2.6675
2.6675
0.9542
6.3933
2.6825 .481 561
.0664
2.7489

2184 2542

TAE

3.2699
7.2343
3.1125
3.6167 .414

1.3664
7.7852
2.1125
2.1641 .0145

Block 8

529
37
20
583

2.7657
2.7657
19 1.2788
6.3933
3.2035
.0664
3.2699

110
54
164

2.2148
2.2148
0.4771
6.3933
1.3000
.0664
1.3664

1600 1860

TAE

20 22
1620 1882

3.8748
7.3809
3.1125
3.3680 .233

3.4885
7.1568
3.1125
3.1578 .572

Block 9

376 2.6191
16 2.6191
30 1.1761
416 6.3933
½ .8076
.0664
2.8740

642 748

296 2.8432
10 2.8432
20 1.3424
341 6.3933
80 3.4221
697 .0664
3.4885

TAE

2640 3.080
3282 3825

3.3762
7.2226
3.1125
3.7113 .514

20
30
~~1464~~
649
55
599

2.7774
2.7774
23 1.3617
6.3933
3.3098 2040 2380
.0664
3.3762
7.6383
1.0145 TAE

10.3 lbs per lamp in distributing mains
143
24 lbs per lamp

$7.38 investment per lamp 100 Ohms
$3.64 for 200 Ohm lamps

3640 for 1000 Lamps

2112
2287
1722
6121

All round
2830
1090
2745
6665

2.6071
7.4834
3.1125
3.1228 .132
1.2956
.0428
1.2732
7.8152
3.1120
2.8309 .0200
3.0138
.0697
3.0835
7.2628 .1
3.1125
3.4565 .285
2.6829
7.3990
3.1125
2.1944 .156

20
193
20
182
395

25966
2.5966
0.9542
6.3933
2.5407
.0664
2.6071

347 405

492
123
20
70
153

2.1847
2.1847
0.5941
6.3933
1.3068

TAE
20.2 25

487
162
225
20
188
13
546

2.7372
2.7372
1.1461
6.3933
3.0138

1030 1200

492
123
369
30
399

2.6010
2.6010
1.0212
6.3933
2.6165
.0664
2.6829

413 882
1810 2112

3.3394
7.1878
3.1125
3.6397 .436

Block n 9 13

500
24
115
10
649

2.8122
2.8122
18 | 1.2553
6.3933
3.2730
.0664
3.3394

1875 2180

TAE

5.0333
7.2924
3.1125
3.4382 ·274

456 2.6590
7.9031
3.1125
3.6746 ·472

500
10

2.7076
2.7078
1.0792
6.3933
2.8877
1.0792
2.9669
.1066
3.0733

TAE

926 1080

For base to give 2 Volts +20% for distrib

456 456
1382 1536

125 feet
20

1.916
20
38.0
12.0
7.6
3.5
45.6.0

249

2.3962
2.3962
0.7787
6.3933
1.9639

92 110
7474 1646

Block 14

100	2.2095		
	2.2095		
162	.3010	TIE	
	.3010		
	.3933		
	1.5148	32	40
180	2.2553		
	2.2553		
W. Wells	.3010		
	.3010		
	.3933		
	1.5059	32	40
		10	10
		74	90

Block 15

268
20
10
298

$$X = \frac{(L-a)(L+a)\,F}{6\,E\,C} + \frac{c}{2}$$

762
298
1060

762
298
464

2.6665
3.0253
.89254
4.6172
.24702
2.1430

TAE

2 | 298
149

139

Feed all

243
10
20
10
283

2.4742
2.4742
.0
6.2933
2.3417

200 225

2.4518
2.4518
1.
6.3925
2.2979

198 225
398

Block 16

200 225

TAE

268
10
278

2.4440
2.4440
.7782
5.6782
2.0595

230 270
124 150
354 420

Block. 17

$$\frac{135}{220} \quad x = \frac{(b-a)(b+a)}{6E.C.} + \frac{C}{2}$$

b = 831 831
a = 220 220
611 1051

TAE

3.0216
2.7880
8.9254
4.7330
2.8287
1.9043

363
13
20
268
10
1674
337

337
80.2
417

363
33
396

2.5977
2.5977
.7782
6 39.33
2.3669
.0664
2.4333

230 270

Block 18

One side		
Same as Block 17	230	270
Jones	150	150

TAE

Block 19.

1.0
2.2
2.0
.95
.10

7.97

197

2.2967
2.2967
0.9502
6.3923

1.9409 x 7.5 ≈

Block 20

.40
.98
40
318
139

2.2765
2.2765
0.9031
6.3913
.8494

70 90

40
192
20
320
20
191
45
823
111

2.1138
2.1138
1.1461
6.3933
2.7670
.8364
.2339

588 681

658 771

2 [3 1/2
157
.0
167

Block 21

.004 2.3617
30 2.3617
.60 = 1
6892 =
4.7148

THE

	60	80
	90	110
	90	110
Estimated	240	300

Block 22

370
35
35
20
460
230

2.3617
2.34.17
1.0792
6.8933
2.1959

TAE

157

Block 23

Same as Block 7 230 270

275 2.4924
36 2.4924
311 1.
6.5933 240 280
2.3789 470

THE

320
370
59
124

2.6149
2.6149
1.0471
5.3733
2.5645 462 550
.0864
1307

1.9031
1.9031
0.4771
5.2933
5446

10 12

Estimate

50 60
10 12
532.634

Block 24

$X = \frac{(b-a)(b+a)\mathcal{F}}{6\mathcal{E}\mathcal{C}} + \frac{c}{2}$

b = 1046 1046 1046
a = 364 682 b+a = 1410

3.1492
2.8338
8.9254
4.9104
2.7642
21462
298
140
158

TAF

206
56
20
215
10
501
134
635
534
101

215
158
57
10
67

Over

Block 25

$a = 634$
$b = 1046$
1680

$$X = \frac{(1-a)(b-a)}{6EC}$$

$1046 - 634 = 412$

TAC

712 feet
2630 lbs

63 lbs.

2630 3.4200
63 1.7993
1.6207

41.8 1.6207
.0057 3.7559
7.3766
.0010
.238 1.6776

.476

916 1069

428
56
342
20
285
22
33
13
712

2.8525
2.8525
1.2553
6.3933
3.3536
.0566
7.4200
2,255.3
1.1647

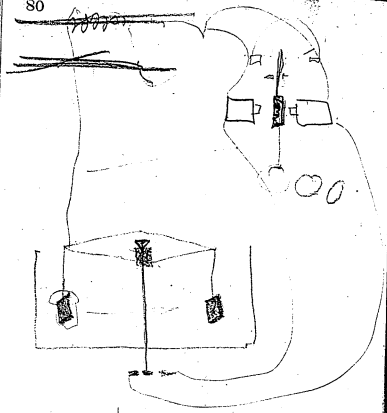
2260 2630
3176 3699

TAE

(14.5 lbs. per lamp
7.25 lbs per 200 Ohm lamps

3.4200
7.1474
3.1125
3.6799

.478



Block 26

a = 220
b = 364
584

364
220
144

2.1584
2.7664
8.9254
3.4502
2.7427
1.1675

TAE

10
193
20
50
303

2.4814
2.4814
0.8129
6.1933
2.1690

147 170

10
193
20
320
10
553
276
.2
288
203
85

Block 26

147 170

320
80
240
10
250

2,3979
2.3979
0.6532
6.3933
1.8423

TAE

70 80

217 250

214

2.3314
2.3314
0.6021
6.3933
1.6582

455 530

307

2.4871
2.4871
1.1461
6.3933
2.5136
.0664
2.5800

Done wrong with

326 380

588 685

Block 27

	20	25
	80	95
214	100	120

37 2.40625
2.40625
5 5 0.6990
6.3933
1.9053

TAE

Block 28

43		2.7490
864		2.7490
10	426	.14150
195		6,3933
10		3.3063 2020 2260
1122		3.0664
561		3727 TAE

Pick 29

13
10
0
179
20
38
20
57
20
128
10
52
16
33
109

2.6117
2.6117
1.1903
6.3933
2.8070
.0664
2.8734

641 747

THE

220
10
28
230

2.3617
2.3617
.9031
6.3923
2.0198

102 12

25
213
20
114
264

2.5623
2.5623
1.1127
6.3923
2.6318
.0664
2.5982

10 1
113 14

112
10
122

2.0564
2.0864
0.6990
6.3733
1.2651

.18 25
659 661

Block 30

$$X = \frac{(b-a)(b+a)\,7}{6EC} + \frac{d}{2}$$

a = 479 752
b = 752 479
1231 273

3.0899
2.4362
8.9254
4.4615

244
10
20
20
294
147
962
5057

2.4683
1.9832

4,45.15
281.29
1.6386

TAE

29
174
20
225
20
213
29
650

90.2

435

Blok 31

20 25

1241
10
16
10
246
20
84
5.04

2.7024
2.7024
10.792
64840
6.3932
2.8573
.2664
2.9437

232
35
32
299

2.4757
2.4757
.9031
1.3932
2.2478
.0664
2.31.42

TAE

754 876

177 207

951 1100

Block 32

2.9706
.0664
3.0370

935 1090

TAF

257	2.4116		
57	2.4116		
230	0.6812		
10	6.2932		
18	1.9977	79	85
256		2	3
57	1.7294		
10	1.7294		
18	8.0792		
85	6.2933		
	3.3313		
135	2.1614		
10	8.1514		
145	8.3979		
	1.1140	13	15
18	2.6180		
97	2.6180		
20	0.9511		
270	2.3932	341	397
10	2.5324		
415	1.0664	435	500
	2.5988		

Block 33

$$\lambda = \frac{(b-a)(b+a)}{6\Sigma c} + \frac{c}{2}$$

$a = 220$ $\quad$ 537 − 220 = 317

$b = 537$

757

TAE

	2.8791	
	2.5011	
	8.9254	
287	4.3056	
10	3.5224	
18	1.8832	76.4
333		
166		
76.4		
2424		

27
28
219
274

2.4378
2.4378
0.6021
6.3933
1.8710 74 90

27
28
193
20
108
378

2.5717
2.5717
0.6990
6.2933
2.2357
.0664
392.1 172 210

105
10
115

2.0607
2.0607
.3010
2.3933
.8157 6.5 7.5
2525 2975

Block 34

$x = \frac{(\phi - a)(k + a)}{}$

a = .537
b = 1051
1588

1051
537
514

TAC

27
28
193
20
211
10
489
244
140
104

3.2010
2.7110
8.9254
4.8374
2.6498
2.1476 140

Block 35

167	2.0899
10	2.0899
10	0.6021
30	6.3933
30	
247	15 20
123	1.1752

THE

10	2.0749
10	2.6749
30	1.3010
30	6.3933
310	1100 1290
20	3.0441 1115
126	.0664
20	3.1105
330	
946	
473	

4.79
2.1
2.12
32
753

Block 36

598 — 2.6031
10 — 2.6031
156 — 1.2553
440 — 6.7937
794 — 2.8548 — 715 — 834
387 — .0664
14
401 — 2.9212

TAE

Blocks 37938

10
135
24
59
228

2.35-79
2.25-79
0.8451
6.3933
1.9542
.066 cu
2.0206

.90 105

TAE

Block 39

200

20 25

2 2010
2 .2010
0.4771
6.3933
47.24

30 35

50 60

TAE

Block 40

196
20
177
10

140

120

TA-EDISON

Block 41

10
15
20
15-8
70
3

73 90

TA EDISON

Block 42

60 75

T A EDISON

Block 43

1792
396
50
456

2.6590
2.6590
1.1761
6.3943
2.8874
.0664
9538

Tax

771 899

30 40

801 939

Block 44

468
570
938

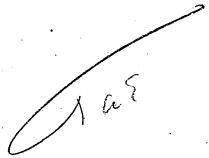
2.7308
2.7308
1.3524
6.3933
3.1973
.0664
.2637

1570 1830

TAC

Block 45

20	25
140	170
160	175



Block 46

30
10
227
20
14
401

2.6031
2.6031
0.9542
6.3933
2.6537
.0664
2.6201

357 . 417

40 60
397 457

TUE

Block 47

192_ 220

TAE

Block 48

409
30
439

2.6425
2.6425
1.2304
6.3933
2.8087
.0664
.8751

644 .75

215

2.3324
2.3324
.6021
6.3933
1.6502

45 60
689 810

TAE

Block 49

418
30
448

2.6513
2.6513
1.3010
8.3933
2.9969
.0664
3.0633

993 1150

TAE

Block 50.

2w / 240

TAE

Block 51.

490 2.7482
30 2.7482
40 1.1051
620 6.3933
3.0368
.0664
3.1032

1100 .260

TAE

6029
214
330) 8151

3.9112
2.5185
1.3927

24.7 lbs cu. per 100 Ohm link

84.

52,300 4.7185 61.000
2664 52.300
61,000 lbs 4.7849 8.700

61.000
88983
149783. lbs to Shipping Department

2777
2112
2670
2800
5— 2289
6M 2184
1620
3282
10— 2040
1810
1475
13 1474
74
15— 398
200
354
150
873
20 659
240
157
470
532
3176
588
100
2020
641
37564

36— 5559
951
935
475
2525
35— 1115
716
90
50
40 100
73
60
801
570
45— 160
397
192
689
993
200
1100
14711
375-64
52275

TUE

Station at corner No 1 to have the conductors brought a shorter route.

21 Stations move for distribution

16 separate lines

396	220
15	10
268	370
10	58
689	215
	10
	883

396	9 of 1013 feet
100	
10	
162	
10	
20	
130	
35	
140	
10	
1013	
160	
853	

3429	4971
4191	6039
1587	2287
1397	2013
10604	15116

15116
10604
4512 lbs less
30
$135.466 Saved

X3 3
90
2970

TAPE

4191
2970
1221 lbs by moving new station
30
$36.630
1354
271030

45-12
1221
5733
1539

Lamps

50

200 hours each lamp
for fifty cts

$\frac{200}{9}$ = 22.2 hours
for a H.P

22.2) 500 (2.2 hrs
44.4
560

$\frac{200}{8}$ = 2.5

~~2.5) 8~~ 2.5) 5.00 (2 cts per hour

50 cts Lamps 50 cts cost per h
3200 at 9 per H.P.

50 cts ~~for~~ cost
7 per H.P. 12 candles each
600 hours TAE
~~9 8~~

~~200 hours 8 cts 9 per~~

7 per H.P. 16 candles cost
300 hours

Lamps 85 cts a cost

~~600~~ 600
~~600~~ 85
3000

For lamps 1 1/3 cts per 3.000

Lamps

50 cts for 111 at 6 per H.P.

50 cts for 200 hours for one burner

50 cts for 200/8 ~~hours~~ ~~lamps~~ for one horse power

50 cts for 25 horse power for one hour

2 cts for 1 horse power for one hour

Lamps

2 cts 7/400 = 57.1

2/7 X 200 = 57.1 cts per M

11.66

Total cost = 66.76 cts

7/400 = 17.4

2/9 X 200 = 44.4 cts per M

Lamp cost 11.66 TAE 2 = 23.33 cts

44.4
23.3
67.7 cts

Lamps

1000 feet

60 lbs per M

12 cent

25
60
1.50 per M

16
8
84 candles mean

TAE

7 per H.P 20 lbs. per 1000 candles

2
7 per lamp per hour

2/7 × 500/12 per 1000 candles

63

13/64

21) 500 (23.8
42
80
63
170

142

143

Lamps
Lamp Cost 600 hours
coating 35 cts

$\frac{600}{12} = 72^{00}$ candles for 35 cts

3.5	1.5441
7.2	0.8573
	6868

4.8 cts TAE

23.8
4.8
28.6 Total cost

144 candles incan. 1oo Hours Lamps 145
9 per H.P. of 16 candles

$\frac{2}{9} \times \frac{125}{8} = 13.9$ cts

16
9
144

9 | 125
13.9

14.45 ; 17.60 :: 15.79

1.1959
1.2455
8.8416
1.2830

TAE

19.20

4.8
9.6

Total cost 13.9 + 9.6 = 23.5 cts

~~24~~ 19
9 of TR

883	831
44	44
290	112
10	40
1221	180
	10
	1217

Station at corner of Block 24 can be made 883 feet from central.

Station		
Lumps		1240
90		1960
145		912
65		1575
110		5687
405		3908
		1779

96.5
40.5
4825
3860
390825

TAE

1779 lbs Cu

From page 135

149.983	5773
7.552	1779
142.431	7552
128.506	
13.925	lbs more than other system

Length of distributing wire in system where it is run separately from all other wires.

35.457 feet

TAE

TAE

Data from which the preceding calculations are made

The lamps are assumed to have a resistance of 100 Ohms.

30 lamps placed 60' apart on a line 1800 feet long, so that there would be a resistance of 10 Ohms to each lamp if the conductors were made up of separate strands. Both conducting wires together weigh 440.7 pounds, and if at the machine there is 100 Volts tension between the lines there will be 87.6 Volts at the lamps 1800 feet from the machine or a drop of 12.4 Volts.

a

The fall in E.M.F will be proportional to the amount of copper in the conductor. There will be the same proportional fall for 150 Lamps 100 feet apart as for 300 if there is ½ the amount of copper in the conductor.

ie. $\frac{4907}{3} = 1469$ lbs Tat

The amount of Copper required varies as the square of the distance that the Lamps are apart. as the square of the distance of the furthest removed Lamp.

Let a = distance to extreme lamp.

b = number of lamps ÷ 10

C = amount of copper in conductor,

X = Fall E.M.F. on conductor a foot long with b lamps on it, C weighing c pounds.

$1800^2 : a^2 :: 146.9 : d$

$d = \frac{146.9\,a^2}{1800^2}$

d = amount Copper that will give 12.4 Volts fall on a conductor a feet long with 10 lamps

$12.4 : X :: \frac{c}{b} : d$

$X = \frac{12.4\,d\,b}{c} = \frac{12.4 \times 146.9\,a^2\,b}{1800^2\,c}$

If instead of 100 Volts to start with there are 110 Volts at the armature then the fall in E. M. F will be $\frac{1}{10}$ greater

$$12.4 + 1.24 = 13.64 \text{ Volts}$$

Then $X = \frac{13.64 \times 146.9 a^2 b}{1800^2 a}$

$\frac{1}{132}$

Let $x = 2.5$ volts it is required to find the value of C for the lamps at a feet from machines

$$X = \frac{13.64 \times 146.9 \times a^2 b}{1800^2 C}$$

$$C = \frac{13.64 \times 146.9 \times a^2 b}{1800^2 \times 2.5}$$

$$\frac{13.64 \times 146.9}{1800^2} = .000618$$

1.1347
2.1676
6.7447
6.7447
6.7911
2.5 0.3979
6.3932

$$C = \frac{.000618 a^2 b}{2.5}$$

$$C = .0002473 a^2 b n$$

$$C = \frac{.000618\ a^2 b}{2.5}$$

$$C = .000247\ a^2 b$$

$\log .000247 = 6.3932$

TAE

100
5.24
94.76

I worked this out in another book and am quite sure that it is right

March 22 1887 [illegible]

Conductor of the same size 165
for the whole length with
Ten lamps on it. 18 ohms feet
apart the total resistance
of the conductor being 1 ohm
If at the machine there
are 100 Volts at the end
of the conductor there will
be 94.76 Volts as a fall
of 5.24 Volts. If at the
machine there is 110 Volts
there will be a fall of
5.764 Volts on the line
and take 405 lbs of Cu
in the line 1800 feet long.

Since the fall is inversely proportional to the amount of copper used in the mains, to compare with the conductor in which there was a fall of 13.64 Volts, there will be n pounds of copper in the uniform sized conductors to give the same fall

$$5.764 : 13.64 :: n : 405$$

$$n = \frac{405 \times 5.764}{13.64} = 171.2$$

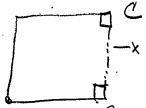
2.6075	$\log n$	= 2.2334
0.7607	$\log .169$	= 2.1670
8.8652		.0664
2.2334	(page 155)	

That is it require 1.165 times as much copper for a straight

conductor as it does for 169
a decreasing conductor to
give the same fall
of E. M. F.

Tae

To find the best point to run the wires to in feed a distributing wire from both ends



TAF

Let $AC = a$
$AB = b$
$Cx = X$
$CB = c$
$Bx = c - X$

If there are n lamps along the conductor BC
$\frac{X}{c} n$ will be fed from C
$\frac{c-X}{c} n$ " " " B.

Data for $\mathcal{F}$

10 lamps at 10 feet require .0125 lbs of cu.

at 1 foot 1 lamp

$$\frac{.0125}{1000} = .0000125$$

Data for $\mathcal{E}$

10 lamps on 1800 feet require 146.9 lbs of Cu

146.9	2.1670
Comp 10.	9.
Comp 1800	6.7447
Comp 1800	2.7447
	4.65564 — 10
	1.1347
	9.6021 — 10
	5.39332
	.0664
	5.45996

Let $\mathcal{F}$ = The weight of copper required in the main line to feed a lamp at a distance of one foot.

$\mathcal{E}$ = The weight of copper required in the distributing wires to feed one lamp at a distance of one foot from distributing point.

$\mathcal{F} = .0000125$ $\log \mathcal{F} = 5.0969$

Decreasing conductor

$\mathcal{E} = 0.000002473$ $\log \mathcal{E} = 5.3932$

Uniform sized conductor

$\mathcal{E} = 0.000002882$ $\log \mathcal{E} = 6.45996$

The values of $\mathcal{E}$ can be obtained easily by substituting in the last equation on page 161

$a = 1$

$b = 1/10$

To supply $\frac{X}{C}n$ lamps through A requires

$\frac{X}{C} n a^2 \mathcal{F}$ lbs. in mains

$\frac{X}{C} n X^2 \mathcal{E}$ lbs. in distributing

To supply $\frac{C-X}{C}n$ lamps from B requires

$\frac{C-X}{C} n b^2 \mathcal{F}$ lbs. in mains

$\frac{C-X}{C} n (a-x)^2 \mathcal{E}$ lbs. in distributing

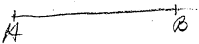
The problem is to make 177
the sum of these weights
a minimum

$$\frac{x}{c} n a^2 \mathcal{F} + \frac{x}{c} n x^2 \mathcal{E}$$
$$+ \frac{c-x}{c} n \cdot b^2 \mathcal{F} + \frac{c-x}{c} n (c-x)^2 \mathcal{E} = \text{min}$$

Differentiated making equal
to zero multiplying by c
and dividing by n we
have

$$a^2 \mathcal{F} + 3x^2 \mathcal{E} - b^2 \mathcal{F} - 3(c-x)^2 \mathcal{E} = 0$$
$$3x^2 \mathcal{E} - 3c^2 \mathcal{E} + 6cx \mathcal{E} - 3x^2 \mathcal{E}$$
$$= b^2 \mathcal{F} - a^2 \mathcal{F}$$
$$6c\mathcal{E}x = b^2 \mathcal{F} - a^2 \mathcal{F} + 3c^2 \mathcal{E}$$
$$x = \frac{(b-a)(b+a)\mathcal{F}}{6\mathcal{E}c} + \frac{c}{2}$$

To find the most profitable place to feed a distributing system



AB a uniform wire on which there is a fall of ~~ten~~ Ta Volts. BC an uniform or decreasing wire on which there is a fall of 2.5 Volts

Let AC = a
" AB = x
" BC = a − x
Let Y = Values on ~~the~~ page 173
& E =

$$x^2 \mathcal{F} + (a-x)^2 \mathcal{E} = \text{min}$$

$$x^2 \mathcal{F} + a^2 \mathcal{E} - 2ax\mathcal{E} + x^2 \mathcal{E} = \text{min}$$

$$\mathcal{F} x^2 + a^2 \mathcal{E} - 2a\mathcal{E} x + \mathcal{E} x^2 = \text{min}$$

$$2\mathcal{F} x - 2a\mathcal{E} + 2\mathcal{E} x = 0$$

$$(2\mathcal{F} + 2\mathcal{E}) x = 2a\mathcal{E}$$

$$x = \frac{a\mathcal{E}}{\mathcal{F} + \mathcal{E}}$$

Tab 9

$\frac{\mathcal{E}}{\mathcal{F}+\mathcal{E}}$			
247	0.3927	.0000125	
372	0.5705	.0006247	
	.8222	.0000372	

66.4% for decreasing

125
288
913

18
17

12
8

35
35
175
105
1225

2

42
42
84
168
1764

2 Ohms

176
122 X 2
61
176

T

W. Water = 0,869 Kilogram

20° = time

49°,8 temperature

$$\frac{0,869 \times 49,8}{20}$$

0,869
49,8
6552
3476
43,2262

2,1638

4,76
225
2380
952
1071
9689,00

225

9689 fr pounds
9689
8,9

39,000

195 | 8,1 | 7
195
81

19

12 | 38

3' .166

.150
2
200

3'.166
150
158300
3160
475900

4 | 475 feet
.119

175 feet to make Ohm
6
1050
4
4200

4200 | 4750 (11.3/100
4200
550
420
130

1050

.113 Ohms